Abstract

This thesis presents various new frameworks of rotation invariant texture feature extraction and addresses the problem of texture feature extraction from an arbitrary shaped region of interest (AROI). New feature extraction techniques aim towards the development of a content-based image retrieval (CBIR) system using texture features.

A promising multi-resolution based rotation invariant texture feature extraction technique is introduced by performing multi-resolution analysis with respect to a reference axis defined as principal texture direction. The independent representation of energies and standard deviation of filter responses along various directions enriches the texture feature and consequently improves the retrieval performance over the existing rotation invariant multi-resolution based techniques which achieve rotation invariance by averaging the direction sensitive filter responses. This improvement is significant for anisotropic textures in case of rotated texture database.

Recent studies on the biological model of vision [2] reveal that the neurons in primary visual cortex are sensitive to intensity gradients at a particular orientation and spatial frequency. Inspired by the biological model of vision, this work attempts to develop a feature extraction framework that extracts texture feature by analysing the spatial distribution of intensity gradient magnitude and gradient angle (measured with respect to principal texture direction) along with that of intensity. The experimental analysis confirms the fact that significant texture information is associated with the spatial distributions of both the gradient magnitude and gradient angle and both these distributions are texture images of their own right. Texture feature obtained by analysing the

spatial distribution of intensity, gradient magnitude and gradient angle is more enriched compared to that obtained by analysing the spatial distribution of intensity alone.

Most of the existing work on texture feature extraction has been done using rectangular images. However, many real life pattern recognition problem require texture feature to be independent of the shape of the arbitrary shaped region of interest (AROI). This work introduces a new texture feature invariant to the shape of the AROI and the orientation of the texture inside it. The proposed approach is based on analysis of joint distribution of intensity, intensity gradient magnitude and intensity gradient direction exclusively within the AROI. The joint distribution of intensity, gradient magnitude and gradient direction represents a global characteristic of the texture independent of the shape of the AROI and intimates the co-occurrence of intensity, gradient magnitude and gradient direction. Analysis of the spatial distribution of intensity, intensity gradient magnitude and intensity gradient direction exploits the local information of the texture. This thesis introduces an enriched version of texture feature obtained by fusing the texture features derived from the analysis of the spatial distribution of intensity, gradient magnitude and gradient angle and texture feature derived from their joint distribution.

Retrieval performance of the proposed texture feature extraction techniques were compared with some established state of the art techniques. A content-based medical image retrieval (CBMR) system for interstitial lung disease has been developed as a real life application of the texture feature extraction techniques proposed in this thesis.

Keywords: arbitrary shaped region of interest (AROI), content-based image retrieval, co-variance matrix, dual tree complex wavelet (DT-CWT), dual tree rotated complex wavelet filter (DT-RCWF), Gabor wavelet, intensity gradient, intensity gradient magnitude, intensity gradient direction, joint distribution, local binary pattern (LBP), maximum response (MR8) filter, principal texture direction, spatial distribution, texture analysis, texture feature, uniform pattern